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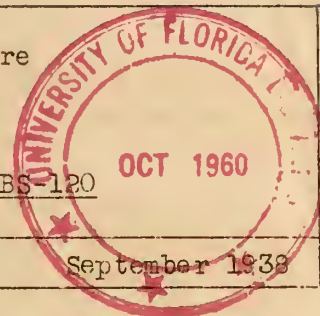
United States Department of Agriculture
Bureau of Biological Survey

Wildlife Research and Management Leaflet BS-120

Washington, D. C.

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September 1938



BOTULISM, A RECURRING HAZARD TO WATERFOWL

With Notes on Recent Outbreaks in the United States
Canada, and Australia

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UNIV. OF FLORIDA
DOCUMENTS DEPT.

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A LITTLE-KNOWN, YET DISMAL PICTURE

Despite the great number of ducks and shore birds that have perished from botulism 1/ in the past quarter of a century, relatively few sportsmen, naturalists, or bacteriologists have ever seen a wild bird afflicted with the disease. Even fewer have witnessed a devastating outbreak. Reasons for this are not hard to find. Besides the fact that outbreaks of botulism among wild birds are localized, sporadic, and often of short duration, they are corollaries of stagnant, steaming, malodorous flats and fathomless mud. They also reach their peak usually beneath the untempered sun of July, August, and September. Under such conditions the "call of the wild" loses some of its appeal even among the more ardent defenders of our thinning lines of waterfowl. By the time the hunting season opens, however, the environmental conditions conducive to the malady may have so changed that it vanishes almost as quickly as it appeared. This led some into the erroneous belief that the shooting that comes with the opening of the season is all that is needed to remedy the situation.

1/ Referred to in earlier literature as alkali poisoning, duck sickness, and western duck sickness.

Intelligent shooting with a rifle in infected areas is one of the few remedial measures at man's command, but promiscuous shooting by hunters whose main objective is to kill birds is quite a different thing.

To those true sportsmen who have viewed the real tragedy of botulism among wild fowl or have experienced the regret that comes from close contact with an outbreak of devastating proportions, the reaction is quite different. In compliment let it be said that there are those whom the sickening sight of botulism has induced to lay aside the gun. At times of such crises, often sudden and unavoidable, the toll of even one added gun is worth saving.

In the summer of 1910 a mysterious malady, demonstrated in later years to be botulism (1)^{2/}, took a disastrous toll from waterfowl dwelling in marsh areas adjacent to Great Salt Lake, Utah. That calamity first attracted national attention to a disease that is today considered one of the most destructive natural checks on migratory waterfowl and shore birds dwelling in or migrating through the States west of the 100th meridian. Still fresh in the minds of men who hunted for the market in those days are the impressions of that epizootic. There are stories of how one could walk for miles along the shore of Willard Spur and Bear River Bay at the northern end of Great Salt Lake stepping from one dead body to another, and when wind and waves had drifted them ashore, dense windrows of carcasses marked the edge. As the season advanced the accumulating bodies created a veritable wildlife shambles, and the resultant decay made it almost impossible to inspect some areas. No one witnessing the devastation that year felt the need or desire of counting the dead. "Millions" seemed so fitting an estimate that the extent of mortality usually was considered on that basis.

It was not until later years, when attempts were made to improve sanitary conditions by gathering and disposing of the bodies, that actual counts were made of the dead. In each of two successive years (1912 and 1913) more than 40,000 birds were picked up in a month at the mouth of Bear River, Utah (5). In 1914, 8,000 to 10,000 dead ducks were found on a 2-mile stretch along one of the lower channels of the Weber River, and in 1932 a conservative estimate placed the season's mortality at the northern end of Great Salt Lake at more than a quarter of a million birds. Interpreted, this is equivalent to the present 1-day bag for each member of an army of more than 25,000 hunters!

Although the marshlands bordering Great Salt Lake have been the scene of more extensive outbreaks of botulism among wild fowl than any other area of equal size, the disease has been reported from the Prairie Provinces of Canada to New Mexico, Arizona, and the Imperial Valley in California; and from southwestern Minnesota, western Nebraska, and the Panhandle of Texas to the west coast. What appears to have been the same malady has also been reported from Mexico, Uruguay, and Australia (1, pp. 31, 32; and 2).

^{2/} Numbers in parentheses refer to the Literature Cited on page 8.

OUTBREAKS SINCE 1932

The foregoing are just a few of the high lights in the story of botulism manifested before its cause was discovered and before information regarding its history and range was compiled (1). The most important outbreaks occurring within the past 5 years (1933-37) are discussed in the following paragraphs. It must be explained, however, that definite bacteriological proof of the presence of this disease is rarely available. When such a diagnosis is lacking, records have been included on the basis of symptoms noted, the course of the epizootic, and the nature of environmental conditions.

It is emphasized, furthermore, that the reported outbreaks doubtless constitute only a fraction of those that actually occur. The more disastrous ones and those that appear in frequented areas are likely to be recorded, but many minor ones may be in inaccessible areas, and these, in the aggregate, may account for a significant total of dead birds. Hence this presentation does not purport to be a comprehensive summary of the outbreaks of avian botulism that have occurred during the period indicated.

In the United States

In the United States, botulism among wild birds during the past 5 years has appeared in what might be termed normal frequency and intensity as judged by the history of the malady during the past quarter of a century. Although there have been no outbreaks of mammoth proportions comparable with that of 1910, mortality has been severe, and the disease has appeared in an increasing number of localities. The latter circumstance is of particular significance, since it may be indicative of a spread of the organism and the malady or an increase in the prevalence of conditions conducive to it.

In the Bear River section of Great Salt Lake, Utah, one of the oldest known points of infection, conditions in 1933, 1934, and 1935 showed improvement over those prevailing when the disastrous outbreak of 1932 occurred (see page 2). Although several thousand dead were found there during each of the 3 years, this number reflected a relatively favorable condition in this highly infected area, particularly in view of the fact that extremely low water prevailed. In 1936 mortality increased, and a conservative estimate of the losses placed the total number of waterfowl succumbing to botulism in the Salt Lake Valley at 50,000, about a fifth of the toll of 1932. Birds died not only on the deltas of all three rivers flowing into Great Salt Lake--the Jordan, the Bear, and the Weber--but many thousands perished at other points in the valley even as far south as Utah Lake, which, from experiences of earlier years, had become known as a point of infection.

In 1936 the Biological Survey and the Utah State Game and Fish Department cooperated in an extensive program of salvaging disabled birds and frightening healthy ones from infected areas. In 1937 the disease again appeared in marked intensity at the northern end of Great Salt Lake,

and rescue operations, facilitated by both "field and base hospitals," effected the recovery of many hundreds of waterfowl. Several hundred ducks, including many ducklings, perished on the shore of Utah Lake as a result of an outbreak soon after the hatching season.

During the period 1933-37 botulism appeared in numerous localities in California. If reliance can be placed on the estimates made of the number of dead ducks and shore birds observed, the outbreak late in the summer of 1933 on the deltas of the New and Alamo Rivers in the Imperial Valley of California is outstanding. On some sections of the shore line the dead lay at the rate of 800 to the linear mile, while estimates of mortality throughout the season reached many thousands. This condition recurred in this same area during the following spring, when death from botulism was confined largely to migrating shore birds. At the other end of California, at Tule Lake in Siskiyou County, the disease had manifested itself for several years, conditions conducive to it prevailing as late as 1937, when rescue operations were carried out. Despite this salvage, it has been estimated that fully 7,000 birds perished that year. The sickness also appeared at several points in the San Joaquin Valley, the scene of outbreaks almost since the beginning of the recorded history of this disease among waterfowl.

In adjacent areas of southern Oregon, on the shores of Upper Klamath Lake, botulism appeared in moderate intensity in the fall of 1934. Although no estimate is available of the number that died, more than 1,000 ducks were brought to recovery pens. Many of these birds regained their strength, were banded, and released. In 1937 for the first time in several years, the sickness broke out in the region of Malheur Lake in southeastern Oregon.

A locality in which botulism among wild birds was recently discovered is Red Lake on the Leupp Indian Agency about 50 miles north of Winslow, Ariz., where an epizootic, apparently of botulism, occurred in the summer of 1933. The lake bed had been dry for several years, but the disease developed when rains flooded part of it during the summer and early fall of that year, and at least 5,000 ducks are believed to have perished. Estimates made earlier in the summer at the peak of the outbreak placed the toll at a much higher figure.

In 1937, reports of botulism came from two points in New Mexico, each representing an additional locality for the disease in that State. At Cheap John Lake, Catron County, 600 to 1,000 ducks died in September and October; while near La Joya, about 6 miles north of San Acacia in Socorro County, several hundred succumbed in an area not far from where mortality was reported 10 years earlier.

In western Nebraska, where, during recent years, the number of infection areas has apparently increased, botulism has appeared in moderate intensity at several points. In 1933 many ducks died at Gay Lake and on other bodies of water near Irwin, and at some of these more birds perished the following year. At Skunk Lake, northeast of Alliance, dead ducks were found at the rate of 50 to the quarter mile of shore in September 1934,

and in the same year fully 1,000 dead were reported at Lake Turcott, southeast of Alliance. Likewise the death rate was high at Deer and Black Steer Lakes, in the same general vicinity, as late as 1937.

In South Dakota, ducks died from botulism at Sand Lake, near Columbia, in 1935, and 2 years later the disease appeared at Lake Oakwood, in the eastern part of the State. In neighboring North Dakota the malady was noted at Upper Des Lacs Lake for the first time in 1934, when many hundreds of birds died presumably from feeding on decaying insects and other invertebrates washed up on the shoreline. About a thousand died there in 1935, and in 1936 an outbreak occurring at the same lake resulted in the death of more than 13,000 birds, a loss outnumbering the wild-fowl production of the surrounding area for that season. Ailing birds were salvaged, and the bodies of the dead were buried by crews of C.C.C. boys, while the healthy ones were herded out of the supposedly infected areas. Long Lake, southeast of Bismarck, a scene of severe mortality in former years, again was the site of an epizootic of moderate intensity in 1937.

Two apparently newly infected areas were recorded in Minnesota in 1937, when certain sloughs in Big Stone County and Lake Shoakatan, Lincoln County, were the scenes of botulism outbreaks. "Many hundreds" were reported to have died in these sections along the western border of the State.

In Canada

During the summer and early fall of 1933, it was estimated that 15,000 to 20,000 ducks and shore birds died at Stobart and Namaka Lakes, about 40 miles southeast of Calgary, Alberta, points where there had been no previous record of disease. At Stobart Lake sick birds were reported in the middle of July by Blackfeet Indians, and the shore line was littered with dead by the first week in August. Low water, high temperatures, and stagnation characterized the environment at the peak of the outbreak. Leeches, in great abundance at Stobart Lake, fastened themselves on the helpless birds and were considered by some observers to be the cause of the malady. At Namaka Lake, however, where the peak of a similar epizootic came a little later, leeches were not plentiful. R. M. Duthie, veterinarian of the Dominion Department of Agriculture, who studied the situation late in the course of the outbreak, concluded that it was "strongly suggestive of a toxemia of some kind" and subsequently stated that, although certain symptoms characteristic of the disease appeared to be absent, botulism may have been the cause. The leeches, he felt, did not play a primary role, although it was generally admitted that the extent of the mortality may have been increased materially by the annelids attaching themselves within the air passages and thus strangling the helpless birds. At a later time (1936) Shaw and Simpson (3) demonstrated that the organism responsible for the outbreak at Stobart Lake was identical with that which had caused the extensive mortality in this country.

Again, in 1934, there was limited early-season mortality among Franklin's gulls nesting at Stobart Lake, and later in the year botulism reappeared among ducks when the water level had lowered considerably.

Between August 15 and September 15, 960 sick birds were gathered and were given wholesome living conditions; of these 72 percent recovered. The waterfowl toll at Stobart Lake in 1934 was estimated at 5,000.

In 1933, 4,000 ducks were reported to have died at Twelve Mile Lake, near Bow Island, Alberta. Although no study was made of this outbreak, the indications are that botulism was the cause.

Of interest, because of its northerly location, is the mortality among ducks reported by J. Dewey Soper, Chief Federal Migratory Bird Officer of the Prairie Provinces of Canada (4). For some years vague reports of dying ducks had come to Dominion officials from the Lake Claire Indians, and during the summer of 1933 opportunity was afforded to search for and locate the infected area. In that season it was found to be on the shores of a body of water north of Welstead Lake, at a point west of Lake Athabasca. Although the mortality was not extensive and bacteriological proof of its cause was lacking, conditions typical of those conducive to botulism prevailed. Should this outbreak have, in fact, been botulism, and Mr. Soper believes it was, it constitutes the most northerly occurrence of the disease among wild birds of which the writer has knowledge--58° 30' north latitude.

Mention may be made of excessive death rate among Franklin's gulls on the Delta Marsh at the south end of Lake Manitoba in June 1934. Red-heads, ruddy ducks, and coots also were affected. There is no conclusive evidence of the cause of the disease, yet it occurred during a period of high temperature and in an environment where a lowered water level had exposed extensive mud flats. These circumstances, together with the fact that the water of Lake Manitoba is somewhat alkaline, are suggestive. This area likewise lies directly north of points in the Dakotas where botulism is known to have occurred. In 1937 newspapers recorded the death of additional hundreds of waterfowl in the same area.

In Australia

A recital of recent manifestations of botulism among wild birds would be incomplete without mention of the noteworthy discoveries made in Australia by E. Murray Pullar in 1934 (2). Not only do Pullar's findings reveal that botulism is a threat against the well-being of wild fowl even on that distant island continent, but they lend a measure of corroboration to the discoveries made in this country (1).

During the Australian summer of 1931-32 botulism was reported at four points in northern and western Victoria. All the outbreaks were associated with hot, dry weather (shade temperature being 95° to 110° F.), low water, and an abundance of rotting vegetation. Hundreds of birds died under conditions strongly suggestive of epizootics that have occurred in the western United States. In the following summer (1932-33) a severe outbreak occurred at the Hume Reservoir, along the Murray River, where the deep mud, rotting vegetation, and decaying bodies afforded an excellent medium for the causative organism.

Of particular interest to bacteriologists are Pullar's conclusions regarding the identity of the organism causing the Australian sickness. This he found to be Clostridium parabolulinum (Seddon), which, as interpreted by American research workers in this field, is considered to be simply a closely related variant of the organism responsible for outbreaks among wild ducks on this continent, C. botulinum type C.

Although Pullar states that the Australian disease does not always appear to be associated with alkaline waters, he apparently had in mind waters of a high saline content, since he found that the water of the Hume Reservoir possessed an alkaline pH of 7.6, while those at other points of infection were even brackish. As pointed out by the American workers (1), moderate alkalinity appears to be highly favorable, perhaps a prerequisite, for the well-being of the causative organism, while excessive alkalinity or high concentrations of salines may destroy the toxin or inhibit growth of the bacterium.

SAFEGUARDS FOR THE FUTURE

With events in Australia paralleling somewhat the course of early ones in North America, certain questions arise concerning the possible future course of botulism among waterfowl. Are added extensions of the range of this malady to be expected not only in North America and possibly South America, but also in Australia? Is this to become a world-wide plague and a threat to wild fowl wherever they are unable to find wholesome living conditions? Is the organism itself undergoing a "period of ascendancy," or are man-made conditions working to its advantage? In the United States many workers believe that man-made conditions have had much to do with the course of events in the West during the past two decades and that a restoration of wholesome, adequate, and stable water supplies will go far toward remedying the deplorable condition.

Thus the engineer often must be called upon to stand shoulder to shoulder with the naturalist and conservationist if future catastrophes, which will destroy added thousands of western wild fowl, are to be prevented. The preservation of these remaining birds is dependent not only on the creation of adequate breeding grounds (and no one questions the grave necessity of this), but the birds raised there must also be provided with paths of migration reasonably free from an over-recurring scourge that has taken a toll of millions. The two must go hand in hand. Unless this can be assured, the best efforts to restore breeding grounds for wild fowl may, in some years, be largely nullified.

With present knowledge of measures for combating the ravages of botulism among wild fowl and with the relatively limited means available for actually carrying out programs of prevention or rescue, the fact remains that for years to come many waterfowl are destined to perish without the possibility of human intervention in their behalf. Despite the extensive efforts being made to restore wholesome habitats, it will be utterly impossible in many areas and at many times to prevent sudden and unexpected onslaughts of this sickness. Until methods and finances permit a more effective control of this disease than is now possible, sportsmen also must realize that here is a natural and often unpreventable drain on wild fowl that apparently did not exist in equal intensity in earlier days.



Until these losses can be curbed, it behooves every duck hunter to bear in mind that the toll of even a single gun may be important in those western areas where the malady strikes with devastating effect. The assertion, heard all too frequently at such times, that "what we shoot is nothing compared with the loss from disease," though true locally, cannot be entertained as a palliative for increased shooting privileges. It is conceivable that as a result of serious outbreaks, as have at times occurred in the Salt Lake Valley, the breeding stock of considerable regions, as well as a large part of the waterfowl produced, may be nearly wiped out. Such outbreaks cannot be predicted with certainty, but when they do appear, sound management practices as well as good sportsmanship calls for a zealous conserving of every individual that can be saved or is fortunate enough to escape the ravages of the disease.

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